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WHAT U.S. PORTS MEAN TO THE ECONOMY

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MARITIME ADMINISTRATION
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Marvin Pitkin,
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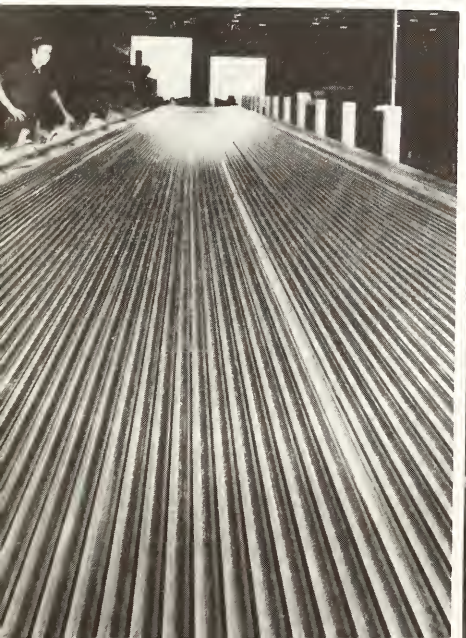


HOWELL LYKES

PORTS ARE GROWTH CENTERS

Every major metropolitan region of the United States centers around a port.

In olden days the arrival of a ship was a great occasion. Almost everyone in the port community turned out to watch her from the moment she first came into sight.

"What ship is she? Where is she from? What is she carrying? What kind of voyage did she have?" These were only a few of the many questions asked as the vessel proceeded to her berth.

The scene was repeated in all ports, whether they were on the oceans, lakes, or rivers. In those simple days everyone knew that any arrival was a benefit for their port and its community. The cargo meant new stock for the merchants' shelves. Availability of the vessel meant activity for the exporters. The loading, storing, repairs, and other port services she would require meant jobs for the port's workers.

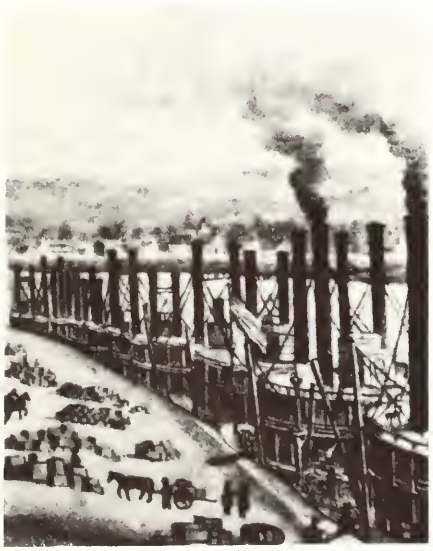
Newly arrived vessels had an added significance in those days. Besides the cargo in their holds and the passengers on their decks they carried news and ideas from the outside world. These were the materials from which civilization was being fashioned.

Ports have continued through the years to be exciting centers of human endeavor and interest. From these centers have grown the regions that became great nations and empires.

The steady progress of the United States to its world leadership in commerce and knowledge has stemmed from its ports. The original 13 colonies began as ports along the Atlantic coastline. As the Nation expanded, new ports were founded along its mighty rivers and Great Lakes. The digging of canals to link its inland waters with the seacoasts stimulated the founding of more new ports.

Today some 170 major commercial ports on the Nation's coastlines, rivers, lakes, and canals serve as centers of regional commerce and growth. Every major metropolitan region of the United States centers around a port, or is closely linked by rail or highway with a port.

In these sophisticated times a whole town rarely turns out for the arrival of a vessel — even a new vessel — as they did in the colorful days of the river steamboats and of the glamorous ocean liners and superliners. Yet the containerships, freighters, tankers, ore carriers, and huge flotillas of barges that arrive daily at river, lake, canal, or coastal ports still symbolize the essential activities of those ports.



SIS Starporter 30ton

Every person in this Nation depends in some ways on its ports. For through the marine terminals move the domestic and foreign commerce that constitutes the food, shelter, and transportation of modern civilization.

The United States Government has long recognized the vital importance of adequate ports to the Nation's economy and defense.

The strategic importance of its ports has been apparent in every war in which the United States has become engaged. World Wars I and II required unprecedented port activity in supplying military and civilian needs during and after the conflicts.

Government has long recognized the vital importance of adequate ports.

Since the founding of this country, the Federal Government has played a diversified role under legislation that has been adopted from time to time by the Congress to assure a healthy and efficient national port industry.

The U.S. Army, through its Corps of Engineers, is mandated to provide and maintain suitable channels in all the Nation's navigable waters. Federal expenditures to carry out this mandate on the sea coasts, rivers, and Great Lakes amount to many millions of dollars annually.

Although everyone has been generally aware that ports mean much in the Nation's economic life, no one could say how much.

The U.S. Coast Guard acts as a safety and policing agency. The Coast Guard maintains lighthouses and channel markers for inland and offshore navigation. It operates ice breakers to keep the ports open during winters. It services harbor radar systems to regulate port traffic. It also licenses merchant marine personnel and enforces safety regulations in ocean and inland ports.

The Maritime Administration (MarAd) of the U.S. Department of Commerce is required by Federal law to promote and encourage regional, State, local and national efforts to provide a dynamic port industry.

Traditionally American ports have acted independently in planning and developing shoreside port facilities as the broad and diversified port industry that exists in the Nation today.

MarAd has focused on port planning and development activities that can result in benefits for all the Nation's ports. In carrying out its mandate, MarAd has undertaken many research projects, alone and in cooperation with various regions, which have had a nationwide application.

To fulfill its mission, MarAd has determined that it needs precise information about the port industry's impact on the national economy. Although everyone has been generally aware that ports mean much in the Nation's economic life, no one can say how much.

To fill the information vacuum, MarAd sponsored this input-output study. It is the first nationwide economic evaluation of the United States port industry. The analysis was contracted to the Port Authority of New York and New Jersey and accomplished through the creation of an input-output (I-O) model with data supplied by the Department of Commerce.

CENTORO

THE MEASURING ROD

Each dollar of sales to the port industry in the base year of the study produced $1.60 in sales within the economy.

The input-output model is an economic tool that is used by industrial and government economists throughout the world for measuring and forecasting economic phenomena.

In this country it consists of more than 8,000 items of data on the Nation's industries arranged in input columns and output rows. This part of the model measures in dollars the production of all goods and services in the United States. In short, it depicts the entire economy.

With the assistance of the computer and by a complicated mathematical procedure, the model's data can be used to derive multipliers that measure the chain reactions that occur in the transactions depicted by the model. This enables the analyst to determine not only the direct economic impact of a transaction, but also its ripple effects throughout the economy.

For example: The purchase of a crane by the port industry directly affects the company that manufactured and sold that crane. But it also affects the manufacturer and supplier of parts for the crane; the manufacturer of the steel used in making the parts; the mining company that produces ore for the steel; and the transportation companies that move each component, from the mine to the crane's final position on the port's waterfront. That chain of event produces the indirect impact.

The ability to produce multipliers is a property peculiar to I-O models. Analysts have known about economic chain reactions for a long time, but until Nobel Prize Winner Wassily Leontief devised the I-O model technique, no reliable means existed for measuring it.

Multipliers differ substantially from one industry to another, depending on the complexity of the chain relationships that are initiated in the production processes of the various industries.

The model gave a multiplier of 1.6 for the chain reactions initiated by all purchases for port industry operations throughout the Nation. This meant that each dollar of sales to the port industry in the base year of the study produced $1.60 in sales within the economy. This consisted of $1 of direct sales plus 60 cents of indirect sales.

PORTS ARE ECONOMIC ASSETS

Gross sales (revenue) of $28 billion within the economy.

A $15.0 billion contribution to the gross national product (GNP).

Since GNP has doubled from base year (1970) of study, all dollar impact totals in 1977 would be nearly double 1970's.

Application of the port industry multiplier to the model's data proved conclusively that the ports are indeed the valuable economic assets to the Nation that they had been believed to be.

This analysis showed that in 1970, the data year of the study, the port industry was *directly and indirectly* responsible for:

- Gross sales (revenues) of $28 billion within the economy.
- A $15 billion contribution to the gross national product (GNP).
- 1,046,800 jobs.
- Personal income of $9.6 billion.
- Business income of $3.7 billion.
- Federal taxes of $5.2 billion.
- State and local taxes of $2 billion.

The base year for the model was 1970 because it was the latest year for which complete official figures were available. GNP is known to have doubled to $1,890 billion — from 1970 to 1977. Thus it can be assumed that 1977 dollar figures for the port industry would be approximately double those of 1970.

It must be remembered in making such an adjustment that nondollar figures such as those for employment and tonnage may not be doubled since they are not as responsive to inflationary trends and other economic forces that have acted recently on the American dollar.

The analysis also revealed the following:

- Port industry handling of U.S. waterborne exports and imports in 1970 was responsible for $16.2 billion of revenues in the Nation's economy.
- The movement of each ton of waterborne cargo in U.S. foreign trade, therefore, generated port revenues of $34. Application of the 1.6 multiplier meant that each ton of waterborne foreign trade contributed direct and indirect revenues of $55 to the U.S. economy in 1970.
- The port industry's handling of each 600 tons of foreign trade in 1970 was responsible for one job in the national economy.
- Every million dollar increase in U.S. exports brought about an average increase of $160,000 in demand for port services.
- Every one million dollar increase in imports required an average $229,000 increase in demand for port services.
- Direct purchases of goods and services by the port industry from other industries in 1970 totaled $8.9 billion.
- The direct and indirect impact on the economy of port investments in 1970 totaled $2.1 billion.

UP
ARGENTINA

PORTS ARE MORE THAN PIERS

What is a port?

This simple question can evoke many answers because the concept of a port seems to differ with individual interests.

To those who love to watch the vessels come and go, the port means arrivals and departures. To the employees of stevedore companies, international banks, freight forwarding companies, marine insurance underwriters, and the U.S. Customs Service it means much more.

The diversity of port concepts encountered presented a problem to the analysts in creating the I-O model for this study. An I-O model requires a precise definition of an industry or group of industries, since the data used in constructing it must be pertinent, complete, and accurate.

No definition or classification of port industry encompassing all port functions had ever been established.

The data research showed that no definition or classification of port industry encompassing all port functions had ever been established. As a result, much pertinent data was buried in other classifications and had to be traced and routed out. This was a meticulous and time consuming process.

Examination of the many regional and local port economic studies that have been made from time to time was of little help. They showed almost as many different port concepts as there were studies. None of them integrated the broad activities of the port industry that truly represent a port's scope and purpose.

Some definitions limited port industry to waterfront activities of loading and discharging vessels. But this definition was too narrow. It excluded many functions that are part of what ports actually do.

Other definitions included production activities that took place in a port area but which had nothing to do with the basic function of serving waterborne shipping. The production of soap, wigs, coffee, sandwiches, or candy at establishments near the waterfront would fit into such a classification.

The broadest definition included activities producing all goods that move by water. The growing of wheat 1,000 miles from a port would be included as port industry if the wheat was exported.

The analysts discarded such definitions as unrealistic, and established the following criteria for a definition that would truly describe port functions and be economically measurable.

- The definition must reflect the port industry's unique mission to move waterborne cargo.
- The definition must be consistent with the true contribution of ports to the national economy.
- The definition must include *only direct* activities of port industry.
- The definition must be formulated in terms of the port industry's output.

Use of these criteria led to a concise definition that would be accurate for any port economic study:

Port industry is any economic activity that is directly needed in the movement of waterborne cargo.

Port Industry is any economic activity that is directly needed in the movement of waterborne cargo.

This definition not only includes the loading and discharging of ships but also the many port activities that take place beyond the piers. It includes such activities as cargo documentation, freight forwarding of waterborne cargo, marine insurance, international banking, warehousing, land feeder services, and all water carrier services.

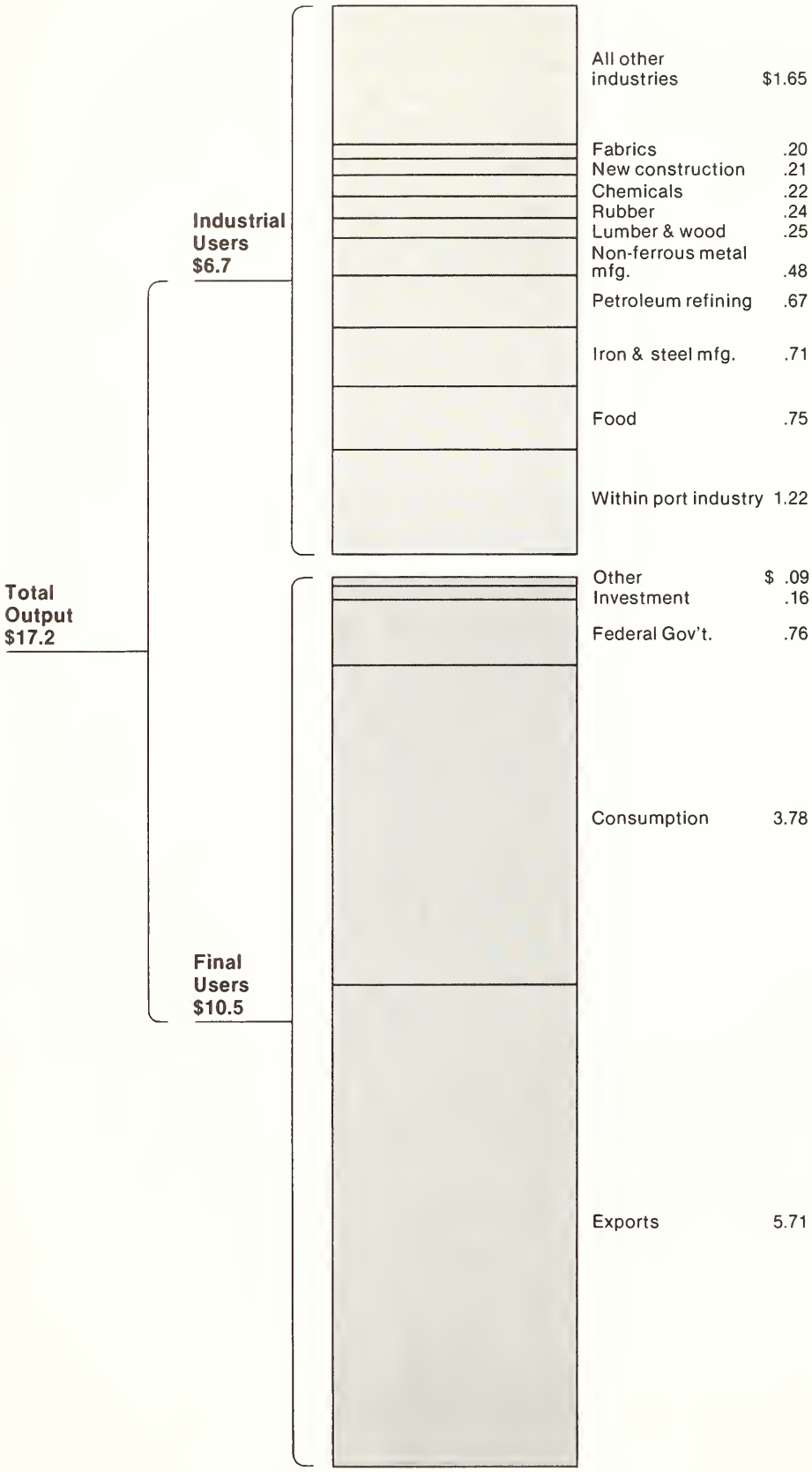
The definition does not include as part of port industry services (output) the activities of port suppliers and users such as ship repair services, fuel, port machinery, and export products. While such activities are part of a port's economic impact, they are not part of its output.

However, the I-O model is a flexible tool and it was used in this study to measure such activities as part of the port industry's input. This will be shown in the following pages.

This definition not only includes the loading and discharging of ships but also the many port activities that take place beyond the piers.

Chart 1
MAJOR USERS OF PORT INDUSTRY SERVICES - 1970
($ Billions)

PORTS ARE SERVANTS



Every day of the study year, the Nation's port industry provided an average of $41 million in services to its users.

Revenue from intermediate sales was 39 percent of the port industry's total output during 1970.

The Nation's port industry provides water transportation services for cargo and passengers. The services include stevedoring; underwriting marine insurance; issuing export licenses; cargo and baggage inspection; warehousing; bank financing of letters of credit; inland feeder services by railroads and trucks; docking and towing; pilotage; freight forwarding; and water carriage by ship, river or lake boats, barges or tankers.

The U.S. port industry in 1970 grossed $17.2 billion from the sales of its services.

Every day of the study year, the Nation's port industry provided an average of $41 million in services to its users—domestic and foreign shippers and passengers, and private and Government customers.

In the study's input-output model those services were sorted into two output classifications called intermediate and final sales.

The intermediate sales are port services purchased by industries for the movement of goods destined for further processing by the buyers. Moving of crude oil to refineries; shipping ore to steel mills; transporting sand and traprock for road construction, are examples of intermediate sales services performed by the port industry.

Final sales are classified as final demand in the input-output study procedures. They are for purchases of port services by passengers and by shippers for moving cargo destined for final consumption. All exports are rated as final demand because they are moved outside the national economy. Some imports are final demand; many are for further processing and therefore are listed as intermediate sales.

The port industry's intermediate sales are a very significant part of its contribution to the national economy. They represent the delivery of raw materials and parts to a large number of U.S. industries some of which could not function without this type of port industry service.

The intermediate sales (output) of the port industry in 1970 amounted to $6.7 billion. This was the revenue from sales to users who required the movement of nearly every type of raw material to their factories, processing plants, and refineries.

Revenue from intermediate sales was 39 percent of the port industry's total output during 1970, and is about the same today.

Several key U.S. industries rely more heavily than others on port services for the transportation of their inputs. They are principally heavy industries such as iron and steel, lumber, rubber, chemical, oil refining, and food processing.

The biggest consumer of port services is the port industry itself. In 1970, it paid $1,220 million for such services.

These payments were for pilotage, tugboat and towboat services; stevedoring; hull insurance; and many other internal transactions in the port industry.

Purchases of $749 million worth of port services by the Nation's food and kindred products industry made it the second major intermediate user of the port industry during 1970.

Purchases of $749 million worth of port services by the Nation's food and kindred products industry made it the second major intermediate user.

The petroleum industry paid $672 million to the port industry.

The food industry's expenditures were mainly for waterborne transportation and cargo handling services required in bringing wheat, corn, rice, sugar, coffee, and other agricultural products by inland and sea transportation to processing and packaging plants throughout the United States. Port services for shipments of processed food products for final consumption were not included in this category.

The huge volume of ore moved by water transport between mines and metal mills provided a large part of port industry revenue. Primary iron and steel manufacturers paid $705 million for such services in 1970; primary nonferrous metal manufacturers paid out another $484 million.

Exports were by far the largest component of the port industry's final demand category.

The petroleum industry paid $672 million to the port industry in 1970 for delivery of crude products to refineries. This figure has probably more than doubled for 1977 due to sharply increased demand and inflation since 1970.

The lumber and wood products industry's payments for port industry services in moving logs and unfinished wood to lumber mills and other plants totaled $253 million during the base study year.

The Government spent $756 million for port services.

The rubber and miscellaneous plastics industry paid $237 million for port services; the chemical industry, $223 million; and the construction industry, $205 million.

While it is apparent from the above sales that payments for intermediate port services have an important impact on the national economy, none of those expenditures was directly entered into gross national product (GNP) accounts in 1970. This was because GNP accounts are limited to final sales; intermediate sales are excluded to avoid duplicate counting of products and services.

Table I in the back of this book lists the 20 leading intermediate users of the Nation's port industry and their expenditures in 1970 for port services.

The sales of port services throughout the Nation in 1970 to final demand (final consumers) were $10.5 billion or 61 percent of the industry's direct revenues for that year.

Final sales are by definition GNP components. They were broken down in this study's I-O model into traditional economic classifications: consumption, investment, inventory changes, exports, and Government expenditures.

Waterborne exports were by far the largest component of the port industry's final demand category. In 1970, they accounted for $5,706 million of the port industry's sales. This was one-third of the industry's gross revenues that year. The remaining two-thirds came from services to domestic trade and to imports.

The port industry's export revenues included payments for cargo handling, for carriage of exports on U.S. merchant vessels and on domestic ocean and inland vessels, and payments for financing export letters of credit and cargo insurance.

The port industry's next highest amount of revenues from final demand services in 1970 was $3,783 million for handling freight and insurance of imported consumer products and the waterborne movement of domestically produced goods headed for final consumer markets.

The private consumption category of imports included thousands of specific commodities — from automobiles and television sets to fruit and meat products. These imports required all kinds of cargo handling, including container, pallet, sling, and roll-on roll-off techniques.

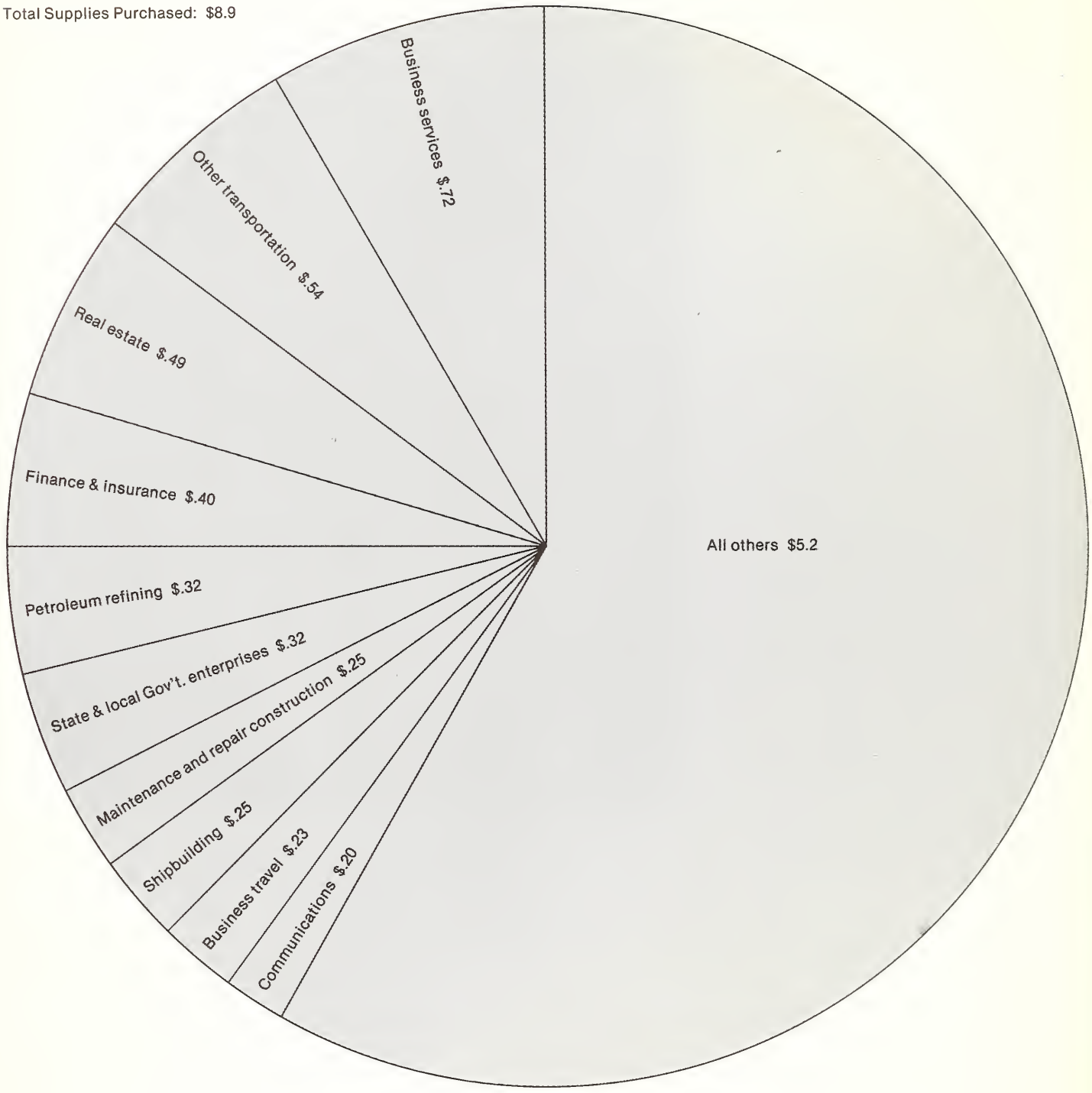
The Federal Government was the port industry's third major provider of final demand revenues. In 1970, the Government spent $756 million for port services to move materials and inputs including military goods.

State and local governments spent an additional $36 million in 1970 for port services.

The private investment sector of the United States was also a significant final user of port services, accounting for $155 million in revenues during the study year. These payments represented the costs of shipping capital goods to their destinations and included domestic and foreign machinery and equipment that moved by water.

Inventory changes in the final demand sector of the port industry itself amounted to $25 million. (See table 2.)

Chart 2
MAJOR SUPPLIERS OF THE PORT INDUSTRY - 1970
($ Billions)



PORTS ARE CUSTOMERS

The port industry must purchase various types of inputs to make its services available to users. Such purchases range from real estate and business services to maintenance, repair, utilities, meals, fuels, office supplies, and other goods and services.

Direct purchases of supplies and service by the port industry in 1970 totaled $8,921 million. During the study year, $6,747 million of the port purchases originated in the domestic economy; $2,174 million in goods and services were imported from other nations.

The port industry's plant and equipment capital investment is not included here, but is dealt with later in this study.

Domestic business services accounted for the largest block amounting to $719 million.

Domestic business services such as promotion, advertising, consulting, legal and accounting services, and dozens of other peripheral business services accounted for the largest block of expenditures by the port industry, amounting to $719 million in the base year of this analysis.

The large expenditures for promotional and other business services indicate the enormous competitiveness within the port industry. Ports and steamship companies both stress the importance of these aspects of their port activities.

Port industry purchases set off a chain reaction.

Purchases from other transportation companies formed the second leading category of port industry expenditures, totaling $537 million. These were for services by domestic truck, rail, air, and freight-forwarding companies in transporting inputs to the port industry.

Rental of properties at port and off- port locations cost the port industry $493 million. Finance and insurance charges amounted to $401 million.

Purchases of fuels for operating port machinery, vehicles, and vessels were also a major expenditure of the port industry, costing $323 million. Maintenance and repair construction amounted to $251 million. Other key industries which made more than $200 million in sales to the port industry during 1970 were shipbuilding, business travel, and communications.

Table 3 lists the 20 principal sources of inputs for the Nation's port industry in 1970.

Port industry purchases set off a chain reaction important to the economy. Direct suppliers of the port industry rely on port purchases in indirect ways as well as the direct purchases analyzed above. That is, goods they sell to industries other than the port industry are used for the production of other goods and services sold to the port industry.

By combining the direct and indirect impact of port industry purchases a better perspective is obtained of the overall reactions of U.S. industries with port services.

The indirect impact can be measured by using the multiplier of 1.6 that was generated for the port industry by the I-O model. Application of this multiplier showed that an additional $10,806 million* of indirect output was required throughout the economy to sustain the direct level of port industry sales of $17,150 million in 1970.

**Adjusted for transferred imports.*

The industry's total impact on the economy averaged about $76 million per day.

Thus the U.S. port industry's combined direct and indirect sales impact was $27,956 million for the base year of this analysis. It meant that the industry's total impact on the economy averaged about $76 million per day during that year.

These figures are quite distinct from the "value added" to gross national product in the model. Using the value added concept, which omits cumulative resale values, the port industry's total annual contribution to GNP in 1970 was $14,953 million and the daily average, $41 million.

The purchasing power of the port industry, with its ripple effect extending to other industries, is of great importance to many suppliers in the Nation.

The ranking suppliers of the port industry, in terms of direct and indirect sales, closely paralleled the port industry's leading direct suppliers in 1970.

Business services of $1,042 million were purchased by the port industry directly and by its suppliers indirectly. Transportation services other than the port industry's were the second leading group of direct and indirect purchases, amounting to $909 million.

Payments of $787 million for real estate and rentals formed the third largest category while the finance and insurance industry ranked as the fourth leading direct and indirect supplier at $649 million.

Shipbuilding industry sold 5.9 percent of its total output in 1970 to the port industry.

Five other broad industry groups made direct and indirect sales of more than $300 million to the port industry and 10 additional groups made sales of $200-$300 million.

Table 4 details the direct and indirect sales of the port industry's 20 leading supplying industries.

The port industry's impact upon the economy other than the above groups of industries runs deeply across a broad front of producers of goods and services. The purchasing power of the port industry, with its ripple effect extending to other industries, is of great importance to many suppliers in the Nation.

The U.S. shipbuilding industry, which sold 5.9 percent of its total output in 1970 to the port industry directly and indirectly, is among those industries which rely heavily on U.S. port services to buy a meaningful share of their outputs. It should be noted that only maintenance and repairs are included here. The purchase of ships is categorized as investment.

Other suppliers in this group include the travel industry which sold 2.3 percent of its 1970 output to the port industry; the nonwaterborne transportation industry which sold 1.6 percent of its output; the maintenance and repair construction, 1.5 percent; and the petroleum refining industry, 1.4 percent.

These percentages include the indirect effect—the impact generated by the sales of each of these industries to other suppliers of the port industry to enable them to produce such supplies in the first place.

PORTS PROVIDE PERSONAL INCOME

Production of port services in the United States during 1970 generated $9,572 million in personal income. The port industry itself paid $6,695 million of that sum in direct payroll while port purchases from other industries were directly and indirectly responsible for $2,877 million in wages and salaries.

Transportation services not part of the port industry were the most benefited in 1970, with $359 million in personal income generated directly and indirectly during the study year by port purchases.

Direct and indirect wages and salaries earned in the business services industry through port purchases amounted to $303 million while $269 million in personal income were generated in the finance and insurance industry.

Other industries that were strongly affected in 1970 in terms of direct and indirect personal income initiated by port purchases were the maintenance and repair construction, $252 million; wholesale and retail trade, $172 million; printing and publishing, $107 million; Federal Government enterprises, $99 million; and communications, $94 million. (See Table 5).

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S
UNION BARGE LINE
J-4

PORTS PROVIDE BUSINESS INCOME

Port activities in the U.S. are important producers of business incomes in cases such as rentals, interest and profits.

Port activities in the U.S. are important producers of business incomes such as rentals, interest, and profits. In 1970, the port industry generated $3,741 million in direct and indirect business income.

Gross profits within the industry itself were $1,661 million while business income generated in other industries was $2,080 million during the study year. This impact was based on an income multiplier of 2.2 derived in the I-O model.

Service industries were the major business income beneficiaries from port activities during 1970. Real estate and rental activities grossed $433 million; business services, $239 million; other transportation outside the port industry, $154 million; and State and local government enterprises, $124 million in income from the port industry during 1970.

Communications, crude petroleum, electric, gas, and water suppliers grossed a total of $279 million from the port industry; the wholesale and retail industry, $63 million; automobile repair and services, $60 million; and maintenance and repair services, $40 million. (See Table 6.)

6546

PORTS PROVIDE JOBS

The U.S. port industry's services require the efforts of every type of worker—skilled and unskilled; professional and nonprofessional; white collar and blue collar.

The input-output model showed that 1,046,800 jobs throughout the United States were directly or indirectly attributable to the operations of the port industry in 1970. Of these, 686,800 persons were directly employed and 360,000 in the various industries supplying the ports.

Transportation that is not part of the port industry was the most strongly affected in 1970 with 45,300 port related jobs in the carriage, transfer, and storage of goods.

Business services hired some 40,600 persons during the study year to supply the port industry; wholesale and retail companies, 31,800; the finance (banking) and insurance business 30,700 to fill port commitments; State and local government enterprises, 13,400; and in port activity related work and Federal Government enterprises, 12,100.

Other industries benefiting directly or indirectly in employment from port activities were the maintenance and repair construction, 17,200 jobs; printing and publishing, 12,100; shipbuilding, 12,000; and communications, 11,100. (See Table 7.)

1,046,800 jobs throughout the United States were directly or indirectly attributable to the operations of the port industry in 1970.

686,800 persons were directly employed and 360,000 in the various industries supplying the ports.

PORTS PAY TAXES

Port activities in the United States are a significant source of Government revenue at all levels. During 1970 the U.S. Treasury collected $5,198 million in taxes directly or indirectly generated by port operations.

Personal income taxes of $1,180 million from incomes generated by port activities were collected by the Treasury; business income taxes totaled $672 million; and Federal excise taxes on waterborne goods came to $1,258 million.

In 1970, Customs collections on waterborne imports totaled $2,088 million. They are included in the port industry's tax category above. Although such collections at the ports are a direct function of port operations, they should be viewed for fiscal planning as a separate source of Federal income. Customs duty payments are better reflected as a function of the value of imports. Such values may be derived independently of the input-output framework.

Aside from the revenues that accrued to the Federal Government, the port industry also contributed meaningfully to State and local tax revenues. In 1970, $1,975 million was received by State and local governments from taxation sources directly or indirectly generated by port operations.

During 1970 the U.S. Treasury collected $5,198 million in taxes.

$1,975 million was received by State and local governments from taxation sources directly or indirectly generated by port operations.

PORTS ARE INVESTORS

$1,187 million was spent by the port industry in 1970 on purchases of capital goods.

The direct and indirect impact of the port industry's capital purchases actually totaled $2,057 million during the study year.

Long-term capital investments for port machinery, vessels, construction of wharves and sheds, intermodal containers, computer hardware, and many other elements are of key importance to the port industry. This has been especially true in the last two decades, in which rapid technological changes and a strong growth in trade have required increased capital expenditures.

Private industry and Federal, State, and local governments make capital investments in the Nation's ports. This section of the MarAd port analysis will focus on private investment. Government investment will be analyzed in the next section.

The input-output model is a static analyzing tool that provides a picture of only 1 year's economic transactions. It is not possible to use the model to measure fully the dynamic impact of port investments.

A static analysis of capital investments' impact on the national economy is limited to the short-run impact-per-dollar delivered to the gross national product—as is the case, for example, of annual operating expenses. In contrast, the dynamic impact of long-term capital expenditures would take into account the impact of improvements in operating efficiency over the years. The model's development has not yet reached that capability.

Therefore, the induced impact that would be generated in future years as a result of the investments in new capacities and technologies in the port industry is not a part of the total impact figures in this study.

Analysis of private investment within this study's framework showed that $1,187 million was spent by the port industry in 1970 on purchases of capital goods. They included ships, communications equipment, harbor craft, river barges and towboats, loading equipment, and other port machinery.

Application of the relevant sectoral multipliers from the I-O model to each type of investment showed that the direct and indirect impact of the port industry's capital purchases actually totaled $2,057 million during the study year.

Shipbuilding was the largest single investment category of the port industry that year. The direct and indirect impact of new merchant ship purchases amounted to $664 million. They covered the costs of new U.S. cargo ships and tankers. Ship repairs and maintenance purchases were not classified as investments.

The second leading category of private port investment was communications equipment. The port industry purchased $146 million in communications equipment for harbor, channel, and open-sea navigation. Radar systems and other sophisticated electronic and telecommunications instruments accounted for the bulk of these purchases.

The primary iron and steel industry was the third largest beneficiary from port industry capital investment—$93 million—mostly through the indirect impact of its sales of materials for new construction of ships, harbor craft, and pier facilities.

The direct and indirect sales impact of private port investment in new construction in 1970 was $82 million; in boat construction, $81 million; transportation equipment other than communications, $68 million; motor vehicles and equipment, $59 million; wholesale and retail purchases, $58 million; engines and tubes, $31 million; and finance and insurance, $25 million. (See Table 8.)

It should be noted that annual port investments fluctuate more than port operations expenditures. Port operations tend toward a continuous volume of traffic flows from year to year; investments tend to be more sporadic. In some years, many more investments are made than in others, depending on the state of the economy.

PORTS AND GOVERNMENT

While the private sector of the U.S. port industry is by far the most important element of port operations, the government sector also plays an important role in waterborne cargo movements. Federal, State and local governments provide a variety of support services and investments that are an integral part of the port industry.

Although port authorities usually are technically part of State governments, they were treated in this study as part of the private sector of port industry because of the nature of their port activities and the technique of the I-O model.

Government port activities totaled $641 million in 1970.

Government port activities such as services, equipment, materials, and facility construction improvements by government agencies totaled $641 million in 1970.

Application of appropriate industry multipliers to each form of government expenditures on ports increased the total impact throughout the economy to $1,457 million for the study year.

These figures excluded government expenditures for the shipping services that were previously analyzed in this study as part of the *output* of port industry.

Appropriate industry multipliers increased the total impact throughout the economy to $1,457 million.

Also excluded were maritime subsidies representing a transfer of funds, and government wages which were not measurable directly from the I-O model's final demand sectors.

Federal Government expenditures covered such activities as channel dredging, waterway maintenance, and the construction of public locks and dams by the Corps of Engineers; coordination of maritime affairs by the Department of Commerce; administration of ocean freight rates and other regulations by the Federal Maritime Commission; collection of tariffs and inspection of merchandise by the United States Customs Service; and implementation of vessel traffic control systems and water safety operations such as channel marking, harbor radar systems, and the licensing of merchant seamen by the United States Coast Guard.

State and local governments also directly participate in various aspects of port planning, construction, and operations. These activities are included in the above impact totals.

In addition, State and local governments generally provide for new infrastructure requirements around ports such as highway access, traffic signals, and the like. But indirect expenditures of this type are rarely associated with the handling of waterborne cargo and are not included in this analysis.

Government port expenditures had a powerful direct and indirect impact on many U.S. industries during 1970. Most affected was the new construction industry with sales of $348 million stemming directly and indirectly from government projects.

The maintenance and repair construction industry benefited by $83 million from government port expenditures that year. Business services directly and indirectly sold $79 million worth of services; wholesale and retail industry came to $48 million.

The ripple effects of governmental port expenditures were strongly felt in demand for construction materials such as metals, lumber, heating and plumbing equipment, and other supplies. The heating and plumbing industry benefited directly and indirectly by sales of $36 million; stone and clay products, by $31 million; primary iron and steel, also $31 million; and primary nonferrous metal, $29 million. (See Table 9.)

Government port expenditures had a powerful direct and indirect impact on many U.S. industries during 1970. Most affected was the new construction industry with sales of $348 million.

Ripple effects of government port expenditures were strongly felt in demand for construction materials such as metals, lumber, heating and plumbing equipment.

Government port functions also produced a meaningful number of jobs. While the I-O model does not provide estimates of the number of government jobs directly related to port activities, other sources such as the "Budget of the U.S.—1970" indicated that about 23,000 Federal employees were primarily engaged in the facilitation of waterborne cargo movements in 1970.

Federal jobs ranged from top administrators to engineers to transportation specialists in the Maritime Administration and the Corps of Engineers. However, the 23,000 figure does not refer to the jobs generated in quasi-government enterprises such as the Export-Import Bank and the St. Lawrence Seaway Development Corporation. They were counted as part of the private sector employment.

Aside from creating jobs within the Government itself, governmental port spending strongly affects civilian employment. Port-related government purchases of goods and services were responsible for an additional 42,000 jobs in the economy in 1970.

Government port spending in 1970 created 11,890 construction jobs. More jobs were created in construction than in any other category. Wholesalers and retailers provided 4,190 jobs in 1970 to expedite various materials and supplies for government port functions. Other business services accounted for 4,140 jobs. (See Table 10.)

PORTS' LIFEBLOOD: FOREIGN TRADE

The port industry serves the Nation by moving its waterborne domestic and foreign commerce. Most U.S. international trade, measured either by weight or value, moves into or out of the country by water transport. Exports and imports are the lifeblood of the ports.

The input-output model has been used to this point of the port industry study to analyze the industry's interaction with other industries and to examine the impact of port activities on jobs, income, and taxes in the national economy.

Most U.S. international trade, measured either by weight or value, moves into or out of the country by water transport.

The model can also be used to analyze the impact of economic events on the port industry itself. Analysis of the impact of foreign trade upon the port industry is an example of the model's usefulness in examining cause and effect relationships from this perspective.

The model can also be used to analyze the impact of economic events on the port industry itself.

In 1970, port services for handling the Nation's waterborne exports and imports were responsible for $16.2 billion of output in the national economy.

This means that the movement of each ton of waterborne cargo by the U.S. port industry in foreign trade generated $34 of port revenue. Applying the port multiplier of 1.6 the direct and indirect revenue throughout the economy amounted to $55 per ton. This does *not* include the value of the cargo itself.

Port services for handling the Nation's waterborne exports and imports were responsible for $16.2 billion of output in the national economy.

International trade not carried by ships consists of the growing volume of high-value international cargo that moves by air transport and the two-way commerce that moves by overland highway and rail transport between the United States and Canada and between the United States and Mexico.

Cargoes valued at $24.5 billion were carried out of the United States on merchant vessels in 1970, or 57.8 percent of the $42.6 billion in exports moved that year. Overland movements to Canada and Mexico and international air cargo accounted for the remainder (42.2 percent).

All waterborne exports, regardless of the flags of the ships on which they moved across the seas, required port services in this country. During the study year, the port industry provided $5,706 million in direct services for moving exports.

Other port activities, including a variety of waterborne services required by the port industry itself in obtaining its input supplies for handling exports, added another $421 million.

A further $657 million in port services was incorporated in the value of the exports. These were services needed in moving raw materials and other input cargoes by water to the export producing industries.

The Nation's total exports of $42.6 billion in 1970 therefore generated a demand for port services amounting to $6,784 million—the total of the three impact areas. This came to 16 percent of the total value of U.S. merchandise exports.

This means that every million-dollar increase in U.S. exports would require an average increase of $160,000 in port services, assuming proportionate increases in the types of export merchandise.

Applying the port multiplier of 1.6, the direct and indirect revenue throughout the economy amounted to $55 per ton.

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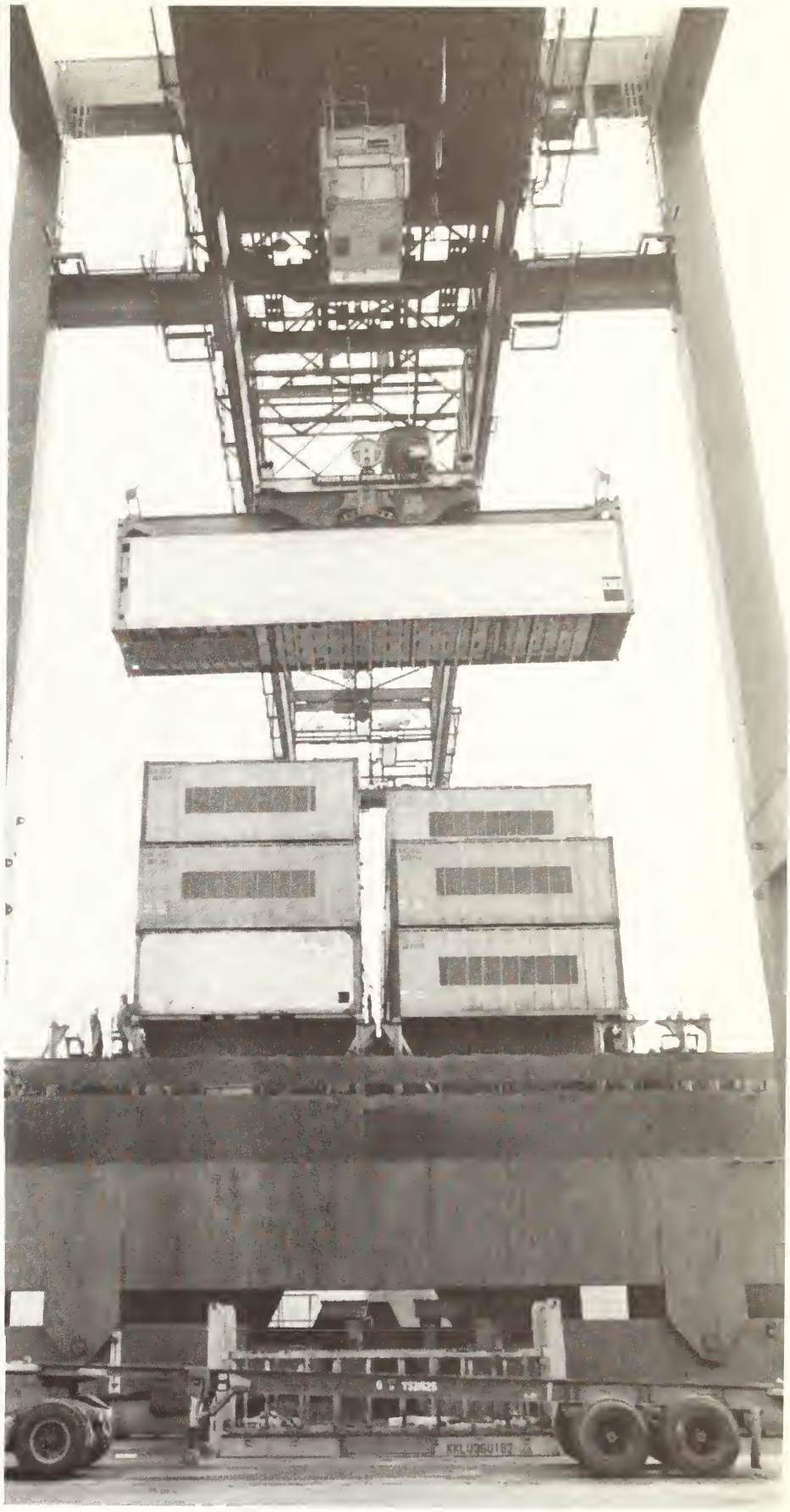

Agricultural exports valued at $3,206 million had to move through U.S. ports. The industry handled 70 percent of the Nation's agricultural exports during the study year.

Waterborne imports, amounting to $25.4 billion in 1970, accounted for 63.8 percent of the total U.S. merchandise imports of $39.8 billion that year.

However, application of such a general ratio throughout the industry is impractical because changes in the level of shipments for specific export commodities have varying impacts on port industry in proportion to their transport costs and their relative reliance on vessel shipments. Such characteristics as weight, size, and value of shipments determine their dependence on water transport.

Because of the weight and bulk of their products, many industries have no feasible alternative to water transport for exporting their products to overseas points. An increase in these exports to such destinations would therefore require port facility expansion in many instances. For instance, all of the Nation's $646 million of coal exports and 98 percent of its $645 million of tobacco manufacturing exports moved abroad by water transport.

Agricultural exports valued at $3,206 million had to move through U.S. ports in 1970 because most of them were bulk shipments of grain which could not feasibly move by other transport. The port industry handled 70 percent of the Nation's agricultural exports during the study year. The remaining 30 percent, mostly fresh fruits and vegetables, moved by overland and air transport.

Food and kindred products were the second leading classification of U.S. exports handled by the port industry during the study year. Eighty-five percent of such products, valued at $2,060 million, moved by water carrier.

Third-ranking were chemicals, with 77 percent of such exports. Chemicals valued at $1,766 million were handled by the port industry in 1970.

Most U.S. exports of construction, manufacturing, and oil field machinery are far too bulky and heavy to move overseas by air transport. In 1970, 76 percent of such exports, valued at $1,372 million, were handled by the port industry. Most of the remaining 24 percent moved to Canada or Mexico by overland transport.

Other leading export products that were handled principally by the port industry in 1970 were primary iron and steel, 77 percent with a value of $972 million; paper and allied products, 91 percent, valued at $922 million; special industry machinery, 75 percent, valued at $843 million; and general industrial machinery, 67 percent, valued at $539 million. (See Table 11.)

Waterborne imports, amounting to $25.4 billion in 1970, accounted for 63.8 percent of the total U.S. merchandise imports of $39.8 billion that year.

Proportionately more imports than exports were carried by seagoing vessels because of an abundance of bulky commodities such as agricultural products, petroleum, and ores that constitute the Nation's inbound cargoes. Waterborne imports weighed 42 percent more than waterborne exports in 1970. Hence, imports required a much larger percentage of the port industry's capacity than exports.

The I-O framework treats imports differently than exports. The reason for this is that imports enter the Nation's economic scene much like any other input in the production and consumption process. They are distinguished only by whether or not they undergo further processing and by the sector purchasing them. This makes it more difficult to estimate their industry-by-industry impact on the ports.

Movements of waterborne imports in 1970 accounted, directly and indirectly, for $9,440 million of port services.

However, it was possible to develop a method of estimating this transportation element and compute an aggregate impact figure for imports.

Through this method it was determined that the movements of waterborne imports in 1970 accounted, directly and indirectly, for $9,440 million of port services, slightly less than 23 percent of the $39.8 billion in United States imports that year.

This meant that generally for each increase of a million dollars of imports, the demand for port services would go up an average of $229,400.

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The higher increase in port services per dollar of imports compared to exports was due in part to the higher tonnage of imports carried by vessels, as noted above. Other factors included U.S. customs duties and excise taxes associated only with imports to this country.

Here too, many U.S. industries depend heavily on water transport in their production process, since vessels offer the only economical transportation for the imports of raw materials or partly finished products they need. Such industries' production could be greatly disturbed if foreign inputs were not available. Consequently, these industries have a great stake in the viability of port services.

The food and kindred products industry depended most on port industry for handling its imports, valued at $3,111 million in 1970. The primary nonferrous metals industry was second, with $1,097 million of waterborne imports. Next came the new construction industry with imports valued at $1,017 million.

The value of the petroleum refining industry's imports totaled $1,013 million in 1970 but have increased relatively much more than any other U.S. import commodity and far exceeded the 100 percent increase in GNP noted earlier for the period 1970-77. (This is because of a combination of inflationary pressures, increased demand for oil products and petroleum production controls that have been imposed by the countries that export oil to the United States since the oil embargo of 1973-74.)

Waterborne primary iron and steel imports during the study year amounted to $1,003 million; radio, television, and commercial equipment imports, $729 million; motor vehicles, $675 million; livestock, $479 million; rubber and miscellaneous plastic products, $451 million; lumber and wood, $379 million; chemicals, $375 million; paper and allied materials, $320 million; and heating and plumbing supplies, $272 million. (See Table 12.)

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WHAT WOULD HAPPEN IF....?

The input-output model's ability to determine impact in two directions—impact of the port industry on the national economy and impact of economic events on the port industry—makes it a valuable economic forecasting and planning tool.

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The input-output model's ability to determine impact in two directions — impact of the port industry on the national economy and impact of economic events on the port industry — makes it a valuable economic forecasting and planning tool.

The model can be used to simulate external changes in the economy and determine their effects on the port industry. It can also analyze the effects of simulated changes in port activities or investment. However, this does not mean that the model can serve as a mechanical forecaster. It does not automatically generate solutions and answers.

Extensive sets of assumptions usually must be made whenever the I-O model is used to simulate the conditions of an external development. These assumptions may relate to the current state of the economy, anticipated changes in technology, the possible impact of other global developments, and, above all, to assumptions that are implicit in all I-O analyses, that is the constancy of input proportion and the transfer of imports and secondary production to primary industries.

Furthermore, special adjustments of the model may be necessary for particular applications.

The following examples illustrate the model's ability to answer three hypothetical questions:

How Would Increased Consumer Spending Affect the Demand for Port Industry Services?
The most prevalent problem that confront producers of goods or services is when, where, and how to adjust to variations in consumer demands for their products, especially increased demands. When this occurs, too little expansion of capital facilities can result in bottlenecks; overexpansion in economic waste.

Decisionmakers in the port industry are continually confronted with the problem of interpreting various available economic indicators in a way that is meaningful to their operations.

Personal consumption data published routinely as part of the national accounting system can be put to good use as business indicators via the I-O model's built-in linkage between the private consumption sector of the economy and the port industry. Private consumption, in this context, would act as a barometer mainly to demand for port service in handling domestic cargo and imports.

Consumer expenditures throughout the United States in 1970 totaled $615 billion. This included $8,171 million for the waterborne movements of these consumer goods (including expenditures for passenger travel by water).

A little more than half the costs of waterborne movements — $4,060 million — represented direct and indirect payments for the transportation of imported products and domestic merchandise for final consumption.

By using the inverse matrix of the I-O model, it was possible to identify and measure the amount of port services absorbed by private consumers through their purchases of all consumer goods and services. This showed that $4,111 million was paid for port services indirectly generated by consumers through purchases of domestically produced goods and services from industries that purchased port services for various inputs in their production processes.

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For example, the model was able to determine that the private consumer was responsible for the indirect consumption of $1,109 million of port industry services in 1970 through the purchases of $72 billion of output from the food and kindred products industry. This amount of port services was incorporated into the value (prices) of the output of food and kindred products industry during its production process.

Through these techniques the I-O model can be used to estimate the impacts of changes in consumer expenditures on demand for port services as follows:

The model was able to determine that the private consumer was responsible for the indirect consumption of $1,109 million of port industry service in 1970 through the purchases of $71 billion of output from the food and kindred products industry.

Assuming that proportionality of input-to-output holds, a 10 percent increase in consumer spending would result in an increase in demand for port services of $817 million (.10 X $8,171 million). This amounts to 5 percent of the port industry's total output of $17.2 billion.

How Would Changes in Industrial Output Affect Demand for Port Services?

Will changes that occur from year to year in the output of every industry in the economy make new demands (requirements) upon the Nation's port industry?

Assuming that proportionality of input-to-output holds, a 10 percent increase in consumer spending would result in an increase in demand for port service of $817 million.

Forecasts of output changes by most industries are available from governmental and private sources. From these forecasts it is possible to estimate future demand for port services by applying the projections to coefficients developed in this study's I-O model.

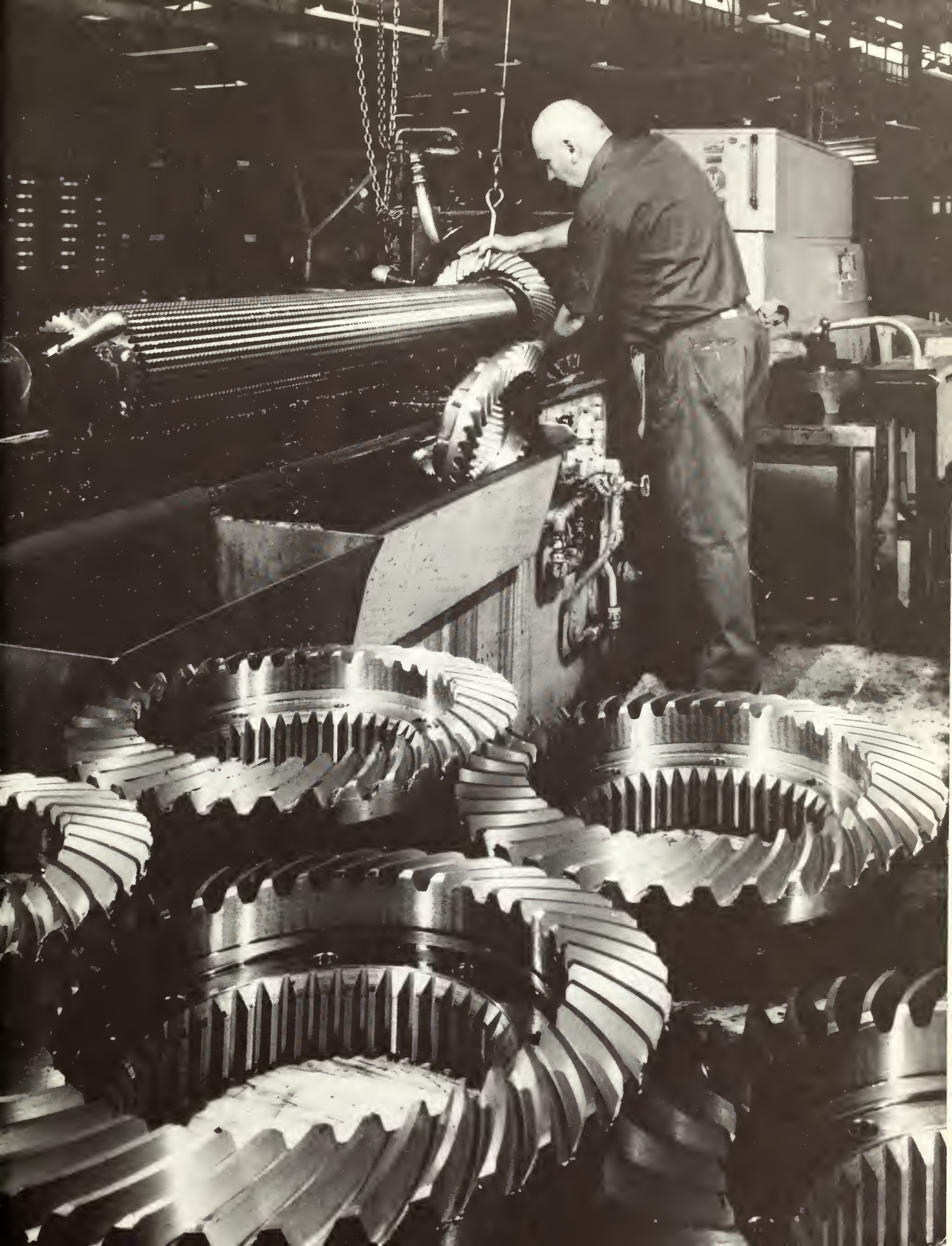
Since each industry requires a different amount of port services in order to increase its output, the impacts of their output changes will vary. Industries that have a strong demand for waterborne transportation services or indirect linkages to other supplying industries that are heavy port users, have a substantially greater economic impact on ports than do industries with little direct or indirect linkages to the port industry.

Furthermore, the total impact of each industry's sales on the port industry depends not only on the strength of these linkages but also on the size of each industry's output. Naturally, industries with greater absolute sales will tend to have a greater overall impact on the ports.

Two methods can be used to demonstrate how a change in the output of each industry affects demand for port service. One emphasizes the absolute changes in industries' outputs; the other emphasizes the relative changes in their outputs.

The first kind of output simulation by individual industries is to compare the impact on the industry of a $1 billion increase in output in each industry. Industries with larger port multiplier effects (direct and indirect demand) will register larger impacts than industries with small multipliers.

The model showed that the industry with the largest impact on the port industry in 1970 was the iron and ferro-alloy industry. Every billion dollars in new sales by this industry required $61 million in new port services.



The industry with the largest impact on the port industry in 1970 was the iron and ferro- alloy industry. Every billion dollars in new sales by this industry required $61 million in new port services.

The model showed that a 10 percent increase in the output of the food and kindred products industry would have the greatest impact, generating a $162 million demand for new port services.

The second leading impact industry was the primary nonferrous metal manufacturing industry, which generated $39 million in new port services for each billion dollars of new output.

Other important impact industries with more than $30 million in new port services demanded for each billion dollars of new sales were primarily heavy industries that required wide usage of port services in their production processes. These industries were nonferrous metal ore mining, $38 million; primary iron and steel, $35 million; petroleum refining, $33 million; and lumber and wood products, $30 million.

The textile goods industry was the leading light manufacturing industry in this category. Each billion dollars of new output of textile goods required some $35 million in new port services. Other industries which generated considerable demand for new port services, according to the model for each billion dollars of new sales, were: forestry and fishery products, $25 million; leather tanning and industrial leather products, $24 million; equipment for other transportation (outside port industry), $24 million; and rubber and miscellaneous plastics products, $23 million. (See Table 13).

The second method of comparing the impact of changes in industrial output on ports is to simulate an equal percentage increase in output for all industries regardless of their sales levels. By doing so, the stress is put on the overall growth impact of each industry's demand for port services rather than the strength of the multipliers.

If a 10 percent increase in output is analyzed separately for each industry, a specific dollar amount of new port services can be determined in every case based on the existing 1970 interindustry relationships and the sales levels existing in that year.

The model showed that a 10 percent increase in the output of the food and kindred products industry would have the greatest impact, generating a $162 million demand for new port services. The second ranking impact industry was the iron and steel with $121 million. New construction was third with $109 million, and petroleum refining came fourth with $104 million.

The demands for new port services generated by 10 percent increases in output by other industries were: Primary non-ferrous metal, $102 million; chemicals and selected chemical products, $52 million; wholesale and retail, $49 million; lumber and wood products, $45 million; and broad and narrow fabrics, $43 million. (See Table 14.)

This information can be very useful for the port industry in making long-term growth projections. What it actually demonstrates is that demand for port services is a derived demand and that the logical approach to projecting demand for new port services is via those industries that generate the demand in the first place.

Even broad indications about the future growth of each of the key industries could be useful from this perspective. For example, if it is expected that a leading impact industry will have sharp growth rates in the short run but much lower growth rates in the long term, a strong signal should be perceived in the port industry about the level of demand for its services. Capacity should then be moderated despite the shortrun boom.

However, if such a key impact industry has a steady long-term growth potential, the demand for new port capacity may be more soundly based despite short-run fluctuations.

Finally, this analytical tool can also help determine whether certain economic developments have only a remote bearing on port traffic. Those industries which need only small amounts of port services directly and indirectly in their production process would not materially affect the port industry even if their output were to double.

By recognizing such industries as wooden containers, chemical fertilizer and mineral mining, agricultural forestry, and fishery services, port management can react much more rationally to future developments in the marketplace.

How Do Dock Strikes Affect the Economy?

Dock strikes always have triggered questions as to their effects upon the economy. Assessments of such effects have appeared in the business trade press from time to time, often with little explanation as to how the assessments were made. Such informal analyses have, nonetheless, found wide acceptance because of the port industry's great importance to almost every industry in the economy.

Creation of an input-output model for this study provided a tool for assessing the economic impact of dock strikes.

To demonstrate how the input-output model can be used to evaluate the economic impact of a dock strike, a simulation was performed using a hypothetical set of assumptions.

Creation of an input-output model for this study provided a tool for assessing the economic impact of dock strikes. However, impact measurement cannot be made with great precision because of a large number of variables that influence the outcome of such a strike.

Key variables that must be taken into consideration in assessing the impact of a strike are:

- Duration of the work stoppage.
- Geographical extent of the strike (ports tied up).
- Expectations of the duration and severity of the walkout and the extent of anticipatory inventory buildup by shippers.
- Lead time warning before the strike's onset.
- Amount of cargo divertable to other modes or routes such as air or overland transport to Canadian, Mexican, or U.S. ports not affected by a stoppage.
- Extent of post-strike recovery of lost tonnage.

Given these basic assumptions about a strike's duration and effectiveness, the I-0 model can generate reasonable estimates of losses in output by the port industry. Moreover, by including specific assumptions on the responses of different industries to a dock strike, its impact can be estimated for the economy as a whole.

Experience gained from past dock strikes has shown that the detrimental impact of a strike increases exponentially (by geometric progression) with time. The daily impact becomes more severe as the strike enters its more advanced stages.

If a 6 month dock strike were in effect on all the Nation's coastlines, waterborne foreign trade and most export production throughout the country would come to a halt. By the end of 6 months there would be a logjam of exports awaiting shipment with no space left for storing them. Alternative short-term outlets of Canadian or Mexican ports or air cargo could not possibly absorb this high level of overflow.

Similarly, industries that depend on imported raw materials with no domestic substitutes would run into major supply problems that would affect production. Many would be forced to shut down for the walkout's duration and for a while afterward, until the flow of imported supplies could be resumed.

As a consequence of a long port industry shutdown, many industries unable to withstand the strike's effects could be forced into bankruptcy with a resulting increase in unemployment and other severe economic disruptions.

In contrast, a strike of only 1 month affecting one coast would have only minor impact consequences for the U.S. economy. Meaningful output losses would occur mainly within the port industry itself. No major impact on production and sales would be noted in such an event, particularly if the duration of the strike was in line with general expectations before it began, or if the delay of seasonal cargo was at a minimum.

The severity of a dock strike's impact for any work stoppage between the 1 month and 6 month durations would depend on the above assumptions. But with each passing day of a shutdown, more industries would begin to be affected.

Industries that depend only slightly on the Nation's foreign trade for supplies or markets would not be affected to a great extent by a strike of short duration. However, beyond a certain amount of time, even these industries could be injured if their domestic suppliers or buyers were severely affected by such a strike.

Therefore, production losses resulting from a dock strike should be carefully assessed in each industry by taking into consideration its individual characteristics in export production relative to total production, existing inventories, warehousing space, alternative supplies, potential bottlenecks, and seasonality of shipments.

To demonstrate how the input-output model can be used to evaluate the economic impact of a dock strike, a simulation was performed using a hypothetical set of assumptions. They were for a strike:

- Of 2-months' duration;
- On the East and Gulf Coasts;
- Affecting all waterborne international and all deep-sea domestic cargo except petroleum;
- With 20 percent of struck waterborne traffic (based on value) diverted to air and overland transport; and
- With 50 percent recovery of traffic through anticipatory shipments and post-strike inventory adjustments (50 percent based on value).

The I-O model showed that a 2-month strike would result in a direct and indirect loss of $1,258 million to the United States economy.

The direct impact would amount to $803 million.

The direct impact of such a strike therefore would amount to approximately 5 percent of the port industry's annual output.

The I-0 model showed that such a 2-month strike would result in a direct and indirect loss of $1,258 million to the United States economy.

The direct impact within the port industry resulting from idling of ships, machinery, loading, and all other parts of the industry would amount to $803 million; the rest of the impact would be diffused throughout the economy through a chain of lost sales to the port industry.

The direct impact of such a strike therefore would amount to approximately 5 percent of the port industry's annual output. A footnote to the above figures is that the strike's impact on port income may be relatively less than on output to the extent that overtime is paid in clearing backlog after the strike is settled or in hedging before the strike is called.

The assumptions for the hypothetical strike were roughly consistent with the characteristics of most U.S. dock strikes during the last two decades. The 2-month duration of the strike probably represents the maximum period in which production in most industries would not be seriously affected.

The joint shutdown of East and Gulf ports has been the rule rather than the exception. These two coasts handle approximately 75 percent of the Nation's waterborne foreign trade. Diversion of 20 percent of the struck cargo to other modes and coasts could mean traffic increases of 40 percent to 80 percent for international airlines and Pacific and Great Lakes ports that remain open.

The role of expectations is extremely important because the impact of a strike can be greatly cushioned by hedging during the warning period. Industries that depend on exports of their products can rush to get off as many orders as possible before the work stoppage deadline; steamship companies push up sailing times so their ships will not be caught in struck ports; industries that depend on imports stock up before the walkout takes place.

Changes in any of the assumptions would lead to different impact figures than those obtained.

It was also assumed that the 2-month duration of the strike was expected, allowing ample warning for an anticipatory buildup of exports and imports by shippers.

In general, the closer the expectations are to the final outcome of the strike, the less negative impact the walkout is likely to have. Correct expectations allow shippers and carriers alike to react by hedging or accumulating inventory to reduce the potential loss of output.

In contrast, incorrect expectations can be costly in overtime and storage costs. If no strike is expected, hedging usually is at a minimum. When an unexpected strike takes place, losses will then be greater. Similarly, if expectations of a prolonged strike do not materialize, short-run misallocations of resources occur at some cost to the affected industries.

The 1970 input-output model has many other potential applications that can shed light on various economic questions that are national in scope.

The assumption that petroleum movements would not be affected simplified the analysis by eliminating the possibility of a crisis stemming from energy shortages. In 1970, petroleum and petroleum products accounted for 10 percent of the U.S. waterborne import value and less than 4 percent of the Nation's export value.

No attempt was made to measure losses in export production and some other repercussions which may result from dock strikes. Such impacts cannot be quantified without extensive surveys. Permanent losses of export markets during a strike because foreign buyers turn to other countries are examples of such unquantified impacts. Domestic bankruptcies resulting directly from dock tie-ups are other examples.

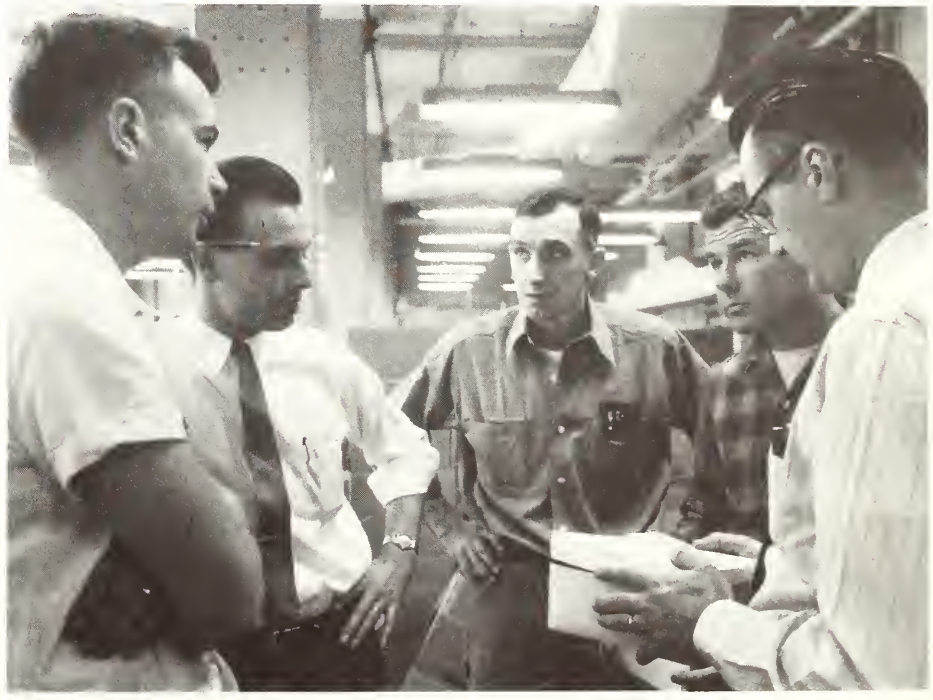
The simulation was therefore based on all the above assumptions and confined to the direct impact on the port industry and the resulting indirect impact throughout the economy as measured by the port industry multiplier in the model.

Further Applications

The 1970 input-output model has many other potential applications that can shed light on various economic questions that are national in scope. Simulations can be made to answer such questions as:

- How many jobs are created as a result of port facility construction of a certain size?
- What would be the impact on the port industry of changes in tax policy?
- What would be the impact on the port industry of changes in Government expenditures?

Special attention would have to be paid in any further simulations of the model to assure that interpretation of results be made only within the limitations of the I-0 model. For example, the model does not account directly for possible supply shortages in the economy or under-utilized labor and capital resources in specific industries.



The national I-O model also can be applied in analyzing regional impact of ports.

The model provides estimations based on conditions existing in the survey year. These must be compared with any new developments in the economy that are not intrinsic to the model.

Updating results into current dollars is another aspect of the analysis which must be handled with great caution. Assumptions of fixed coefficients may hold less for certain specific industries than for others.

Moreover, real economic growth and inflation vary by industry. It may be insufficient to merely use trends in real gross national product growth and price deflators to obtain a current dollar impact figure for the port industry. It would be preferable to use more precise data for such purposes.

The national I-0 model also can be applied in analyzing regional impact of ports. Obviously, the total impact of the national port industry is made up of the various regional components, with each region contributing its share depending on the amount of direct port activities taking place within it and on the direct linkages that it has with the rest of the economy.

Since different regions tend to be more specialized in the handling of different commodity groups, and since regions also tend to have a nonhomogenous productive base, the regional economic impact of ports cannot be achieved by dividing the national impact by any simple weight factor.

For example, it is not appropriate to use regional trade volumes by vessels as proxies for regional impacts. Nor should any other single indicator such as regional population, income, or production serve such a purpose.

The national model can be extremely useful, however, in drawing some inferences from the linkages of regional ports to specific national industries. The model is able to pinpoint the industries that benefit most from the existence of a port industry. Conversely, the model can pinpoint the port industry that benefits most from certain industries. Each region can evaluate its own position relative to the national standard. In addition, by using various adjustments, national impact yardsticks derived by the model can be refined to approximate regional impacts.

For example, regions that handle bulk items primarily could compensate their impact estimates per ton by lowering them in some proportion to the national norm. On the other hand, regions that specialize in general cargo commodities, or which have a strong international banking sector, could compensate in the other direction above the national average.

Although these crude methods do not provide precise regional measures, they could serve a useful purpose in gauging overall impact trends in various regions.

Actually, all of the factors that make a region unique economically must be taken into consideration when making inferences from the national model. Not only must ratios of bulk to general cargo be analyzed but also the proportions of export, import, and domestic trade as well as regional production and consumption patterns.

All of which indicates that while the national I-0 model does provide a valuable blueprint for the derivation of a regional I-0 study of individual ports, the national study in itself is not a substitute for a more refined regional analysis.

The national model can be extremely useful, however, in drawing some inferences from the linkages of regional ports to specific national industries.

IMPACT TABLES

TABLE 1
Interindustry Sales of the U.S. Port Industry - 1970
($ Millions)

Purchasing Industry	Amount
Port services	$1,220
Food & kindred products	749
Primary iron & steel manufacturing	705
Petroleum refining	672
Primary nonferrous metal mfg.	484
Lumber & wood products	253
Rubber & misc. plastic products	237
Chemicals	223
New construction	205
Fabrics, yarn & thread	199
Paper & allied products	183
Stone & clay mining	181
Radio, television & communication equipment	178
Other agricultural products	170
Misc. manufacturing	127
Federal Government enterprises	114
Misc. textile goods	112
Wholesale & retail trade	107
Iron & ferroalloy ores mining	97
Nonferrous metal ores mining	84

TABLE 2
Expenditures for Port Services by Final Demand Sectors - 1970
($ Millions)

Final Buyers	Amount
Exports	$5,706
Consumption	3,783
Federal Government	756
Investment	155
State & local government	36
Inventory	25

TABLE 3

Direct Input Requirements of the U.S. Port Industry by 20 Leading Supplying Industries - 1970

($ Millions)

Supplying Industries	Amount
Business services	$719
Other transportation	537
Real estate and rental	493
Finance and insurance	401
Petroleum refining	323
State and local gov't enterprises	320
Maintenance & repair construction	251
Shipbuilding	251
Business travel & entertainment	228
Communications	203
Automobile repair & services	169
Other fabricated metal products	149
Wholesale & retail trade	117
Food & kindred products	105
Electric, gas, water and sanitary	88
Primary iron & Steel manufacturing	81
Federal Government enterprises	73
Rubber & misc. plastic products	70
Primary nonferrous metal manufacturing	68
General industrial machinery & equipment	61

TABLE 4

The Direct & Indirect Requirements of the U.S. Port Industry by 20 Leading Supplying Industries - 1970

($ Millions)

Supplying Industry	Amount
Business Services	$1,042
Other transportation	909
Real estate	787
Finance & insurance	649
Maintenance & repair construction	477
Petroleum refining	456
Wholesale & retail	402
State & local government enterprises	395
Business travel	311
Primary iron & steel	297
Printing & publishing	288
Communication	287
Electric, gas	280
Food & kindred products	261
Shipbuilding	253
Crude petroleum	229
Primary nonferrous metal	234
Other fabricated metal	218
Automobile repair & service	217
Paper & allied products	195

TABLE 5

Direct and Indirect Personal Income Generated by the U.S. Port Industry by the Ten Leading Supplying Industries - 1970

($ Millions)

Supplying Industry	Amount
Other transportation	$359
Business services	303
Finance & insurance	269
Maintenance & repair construction	252
Wholesale & retail trade	172
Printing & publishing	107
Federal Government enterprises	99
Communications	94
Primary iron & steel manufacturing	85
State & local government enterprises	81

TABLE 6

Direct and Indirect Business Income Generated by the U.S. Port Industry by the Ten Leading Supplying Industries - 1970

($ Millions)

Supplying Industry	Amount
Real estate & rental	$433
Business services	239
Other transportation	154
State & local government enterprises	124
Communications	102
Crude petroleum	101
Electric, gas and water	76
Wholesale & retail	63
Automobile repair & services	60
Maintenance & repair services	40

TABLE 7

Direct & Indirect Employment Impact of the U.S. Port Industry in the Ten Leading Supplying Industries - 1970

Supplying Industry	Employment
Other transportation	45,300
Business services	40,600
Wholesale & retail	31,800
Finance & insurance	30,700
Maintenance & Repair construction	17,200
State and local government enterprises	13,400
Printing and publishing	12,100
Federal Government enterprises	12,100
Shipbuilding	12,000
Communications	11,100

TABLE 8

Direct and Indirect Sales Impact of Private Port Investment in the 20 Leading Supply Industries - 1970

($ Millions)

Supplying Industry	Amount
Shipbuilding	$664
Communication equipment	146
Primary iron & steel	93
New construction	82
Boat construction	81
Other transportation equipment	68
Nonferrous metal	66
Motor vehicles & equipment	59
Wholesale & retail	58
Heating & plumbing	46
Business services	39
Other transportation	34
Engines & tubes	31
General industrial machinery	31
Lumber & wood products	30
Other fabricated metal products	28
Finance and insurance	25
Real estate and rental	25
Electronic components	21
Electric, gas	19

TABLE 9

Direct & Indirect Output Impact Of Government Port Expenditures on the Twenty Leading Supplying Industries - 1970

($ Millions)

Supplying Industry	Amount
New construction	$348
Maintenance & repair construction	83
Business services	79
Wholesale & retail	48
Heating & plumbing	36
Stone & clay products	31
Primary iron & steel	31
Primary nonferrous metal	29
Lumber & wood products	28
Other transportation	26
Electric & gas	20
Construction & mining mach.	19
Electric industrial equipment	19
Printing & publishing	19
Hotel & personal services	18
Real estate & rental	16
Service industry machines	14
Finance & insurance	13
Shipbuilding	13
Petroleum refining	12

TABLE 10

Direct & Indirect Jobs Generated By Direct Government Port Expenditures in the Twenty Leading Supplying Industries - 1970

Supplying Industry	Jobs
New construction	11,890
Wholesale & retail	4,190
Business services	4,140
Maintenance & repair construction	2,910
Hotel & personal services	1,390
Other transportation	1,240
Stone & clay products	1,120
Primary iron & steel	900
Printing & publishing	790
Electric industrial equipment	720
Finance & insurance	530
Construction & mining machinery	520
Primary nonferrous metal	490
Other fabricated metal products	400
Shipbuilding	390
Office & computing machines	350
Federal Government enterprises	290
Electric lighting equipment	250
Communication	240
Forestry & fishing products	220

TABLE 11
Leading Waterborne Export Industries in the United States · 1970
($ Millions)

Industry	Value	Water Penetration
Agricultural products	$3,206	70%
Food & kindred products	2,060	85
Chemicals	1,766	77
Construction, manuf. & oil field mchy.	1,372	76
Primary iron & steel	972	77
Motor vehicles & equipment	959	33
Paper & allied products	922	91
Petroleum refining	874	92
Special industry machinery	843	75
Primary nonferrous metal	828	76
Coal mining	646	100
Tobacco manufacturing	645	98
General industrial machy.	539	67
Lumber & wood products	471	77
Service industry machines	425	83
Metal working machy.	419	67
Engines & turbines	373	70
Other fabricated metal products	362	66
Drugs, cleaning & toilet preps	359	57
Ordinance & accessories	342	86

TABLE 12

Ranking of Waterborne Imports by Consuming Industry in the United States - 1970

($ Millions)

Industry	Value
Food & kindred products	$3,111
Primary nonferrous metals	1,097
New construction	1,017
Petroleum refining	1,013
Primary iron & steel	1,003
Radio, television & comm. equipment	729
Motor vehicles	675
Livestock	479
Rubber & misc. plastics products	451
Lumber & wood products	379
Chemicals	375
Paper & allied products	320
Heating & plumbing products	272
Wholesale & retail	255
Other agricultural products	245
Office, computing & accounting machines	234
Electric & gas	220
Misc. manufacturing	219
Business services	182

TABLE 13

Increase in Port Industry's Output Resulting from Additional Sales of Other Key Industries - 1970

(Millions of Dollars per $1 Billion Sales by Other Industries)

Industry in Which Output Increased $ 1 Billion	Resulting Port Output (in $ millions)
Iron & ferro-alloy ores mining	$ 61
Primary nonferrous metal manufacturing	39
Nonferrous metal ore mining	38
Primary iron & steel	35
Misc. textile goods	35
Petroleum refining	33
Lumber & wood products	30
Forestry & fishery products	25
Leather tanning and industrial leather products	24
Other transportation equipment	24
Rubber & misc. plastic products	23
Misc. manufacturing	21
Chemicals	20
Paper & allied products	19
Paints & allied products	19
Metal containers	19
Other fabricated metal products	18
Plastic & synthetic materials	18
Heating & plumbing equipments	18
Special industry machinery	17

TABLE 14
Increase in Port Industry's Output Resulting from Ten Percent Additional Sales of Other Key Industries - 1970
($ Millions)

Industry in Which Output Increased	Resulting Port Output
Food & kindred products	$162
Primary iron & steel	121
New construction	109
Petroleum refining	104
Primary nonferrous metal	102
Chemicals & selected chemical products	52
Wholesale & retail	49
Lumber & wood products	45
Broad & narrow fabrics	43
Rubber & misc. plastic products	40
Paper & allied products	38
Livestock & livestock products	36
Real estate & rental	34
Other agricultural products	33
Apparel	32
Radio, television & communication equipment	31
Electric & gas	28
Other fabric metal products	26
Other transportation	26
Heating & plumbing equipment	25

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Report written by:

Economists

Jerome Gilbert, project leader
Nai-Ching Sun
Amos Ilan

Technical assistance provided by:
John Pisani, Maritime Administration and
Philip M. Ritz, Bureau of Economic Analysis,
U.S. Department of Commerce

Consulting Editor
Walter Hamshar

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